PATENT ABSTRACTS OF JAPAN

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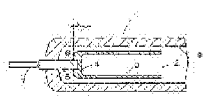
(54) **ELECTRODE ALLOY FOR FLUORESCENT DISCHARGE TUBE, ELECTRODE FOR THE FLUORESCENT DISCHARGE TUBE AND THE FLUORESCENT DISCHARGE TUBE PROVIDED WITH THE ELECTRODE**



(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electrode alloy for fluorescent discharge tube, improving the brightness of a lamp and superior in its moldability, an electrode for fluorescent discharge tube and a fluorescent discharge tube provided with the electrode.

SOLUTION: The electrode alloy for the fluorescent discharge tube is formed by Ni-W alloy containing 2.0 to 10 mass% of W and the remainder substantially from Ni, Ni-W-Nb alloy, Ni-W-Ta alloy or Ni-W-Nb-Ta alloy containing 2.0 to 6.0 mass% of W and 0.5 to 2.0 mass% in total weight of one or two type(s) of elements of either Nb or Ta and the remainder substantially from Ni. The electrode for the fluorescent discharge tube 2 is formed by the electrode alloy and is provided with a tube part 3 with one end open and an end plate part 4 sealing the other end of the tube part 3. The end plate part 4 is formed thicker than the tube wall thickness of the tube part 3. In the end plate part 4, a recessed part 6 for aligning a conductor for power feeding can be formed into a concentric state to the tube part 3.

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CLAIMS

[Claim(s)]

[Claim 1]

W -- 2.0 - 10mass% -- containing -- the remainder -- the electrode alloy for the fluorescence discharge tubes which consists of nickel substantially.

[Claim 2]

one sort or two sorts of elements chosen from 2.0 - 6.0mass, and Nb and Ta in W -- the total quantity -- 0.5 - 2.0mass% -- containing -- the remainder -- the electrode alloy for the fluorescence discharge tubes which consists of nickel substantially.

[Claim 3]

It is the electrode for the fluorescence discharge tubes equipped with the tube part from which the end was released, and the end plate section which blockades the other end of said tube part,

The electrode for the fluorescence discharge tubes in which it was fabricated in one and the wall-thickness halfbeak of a tube part was also thickly formed for said end plate section with the electrode alloy which said tube part and end plate section indicated to claims 1 or 2.

[Claim 4]

Said end plate section is the electrode for the fluorescence discharge tubes indicated by claim 3 by which said tube part and the crevice for conductor positioning arranged concentrically were established in the outside.

[Claim 5]

It is the fluorescence discharge tube equipped with the electrode of a couple which the fluorescent screen was formed in the internal surface, has been arranged the glass tube with which the gas for discharge was enclosed with the interior, the conductor for feed closed by the both ends of the glass tube in the shape of penetration a glass tube, concentric, and within and without the glass tube, and inside said glass tube, and was connected to the edge of said conductor for feed,

The fluorescence discharge tube with which the electrode for the fluorescence discharge tubes indicated by claims 3 or 4 as said electrode was used, and joining of said conductor for feed was concentrically carried out to the outside of the end plate section of said electrode.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs]

This invention relates to the fluorescence discharge tube used as a back light of liquid crystal, its electrode, and electrode material.

[0002]

[Description of the Prior Art]

The fluorescence discharge tube small as a back light is used for liquid crystal equipment. The fluorescent screen (graphic display abbreviation) was formed in the internal surface, and this fluorescence discharge tube is equipped with the glass tube 11 with which the gas for discharge (rare gas and mercury vapour, such as argon gas) was enclosed with the interior, and the electrode 12 which constitutes the cold cathode of the couple prepared in the both ends of the glass tube 11, as shown in drawing 3 . Said electrode 12 is formed in one in the shape of a cylinder like object with base of the tubed tube part 13 from which the end was released, and the end plate section 14 which blockades the other end of this tube part 13. The end of the conductor 15 of the shape of a rod closed so that the edge of said glass tube 11 might be penetrated is welded to said end plate section 14, and lead wire 17 is connected to the other end of this conductor 15.

[0003]

Said electrode 12 is conventionally formed with pure nickel, and the size is [which has a small back light etc.] for the fluorescence discharge tubes about 0.1mm in the bore of about 1.5mm, the overall length of about 5mm, and thickness of a wall 13, for example. This tubed electrode is fabricated in one by carrying out deep-drawing shaping of the pure nickel sheet metal which usually has thickness equivalent to the thickness of said tube part.

[0004]

As a technique about the electrode for the fluorescence discharge tubes, in order to raise a lamp life, forming an electrode with Nb, Ti, low Ta, or these low alloys of a sputtering yield is indicated by JP,2002-110085,A (patent reference 1).

However, an expensive top, these high-melting oxidizing quality metals need to manufacture bulk material by different special approaches from usual dissolution and casting, such as a plasma-arc-melting method and powder-metallurgy processing, and have the problem that fabricating-operation nature is dramatically bad and cannot carry out a fabricating operation to a tubed electrode easily like pure nickel further as compared with pure nickel.

[Patent reference 1]

JP,2000-3973,A (claim)

[0005]

[Problem(s) to be Solved by the Invention]

Although the electrode for the fluorescence discharge tubes mainly had the good moldability as above-mentioned and it was formed with pure nickel stable also in construction material, improvement in brightness is called for with the miniaturization of the fluorescence discharge tube. Although what is necessary is just to lower the pressure of the gas for discharge (rare gas) enclosed with the discharge tube in order to raise brightness, it becomes easy to produce the phenomenon (sputtering) which ion etc. collides and emits an atom to an electrode from an electrode metal in the case of burning. Consequently, since the atom of an electrode metal combines with the mercury enclosed in the glass tube and mercury vapour is exhausted, there is a problem that a lamp life falls. Moreover, since the end plate section has only thickness equivalent to a tubed body, the conventional tubed electrode has a severe welding condition at the time of welding the conductor for feed, and poor joining tends to produce it. For this reason, there is a problem of the electric and thermal junction to an electrode becoming uncertain, a discharge condition and a heat dissipation condition becoming unstable, and the brightness of the fluorescence discharge tube falling, and becoming easy for a lamp life to fall.

This invention was made in view of this problem, is excellent in fabricating-operation nature, and aims at offering the electrode for the fluorescence discharge tubes which can prevent lowering of the brightness resulting from

offering the electrode alloy for the fluorescence discharge tubes which can moreover raise the brightness of the discharge tube, and poor joining of the conductor for feed, and lowering of a lamp life, and offering the fluorescence discharge tube further equipped with the above-mentioned description.

[0006]

[Means for Solving the Problem]

the electrode alloy for the fluorescence discharge tubes by this invention -- W -- 2.0 - 10mass% -- containing -- the remainder -- the nickel-W alloy which consists of nickel substantially, or W -- any one sort or two sorts of elements, 2.0 - 6.0mass%, and Nb and Ta, -- 0.5 - 2.0mass% -- containing -- the remainder -- it is formed with the nickel-W-Nb alloy, nickel-W-Ta alloy, or nickel-W-Nb-Ta alloy which consists of nickel substantially.

[0007]

The brightness of the fluorescence discharge tube can be raised under the same discharge conditions, securing the fabricating-operation nature which does not have inferiority in nickel practically to pure nickel at that of optimum dose **** in W excellent in the electron emission characteristic according to this electrode alloy. Moreover, the sputtering yield of an electrode can be reduced and a lamp life improves [add / two sorts / one sort or / of Nb and Ta / with 0.5 - 2.0mass% / slightly]. Since the extent is larger than W about 2 times, to Nb and Ta also degrade fabricating-operation nature, and carry out compound addition of these elements with W, it is necessary to make the upper limit of the amount of W 6.0%.

[0008]

Moreover, the electrode for the fluorescence discharge tubes by this invention is equipped with the tube part from which the end was released, and the end plate section which blockades the other end of said tube part, said tube part and end plate section are fabricated in one with said electrode alloy, and the wall-thickness halfbeak of a tube part is also thickly formed for said end plate section.

[0009]

Since according to this electrode the thickness of the end plate section to which

joining of the conductor for feed is carried out is formed more thickly than the thickness of the tube wall of a tube part even if it is the case that the thickness of the tube wall of a tube part is thin In case the edge of said conductor is end plate welded in the shape of comparison, the edge of a conductor can be end plate welded easily, without performing delicate control of joining outputs, such as a welding output, and both poor joining can be prevented. For this reason, the electric and thermal junction to a conductor and an electrode becomes certain, a discharge condition and a heat dissipation condition are stabilized, and the brightness of the fluorescence discharge tube and lowering of a lamp life can be prevented. Moreover, the manufacture yield of the fluorescence discharge tube can be raised.

[0010]
 In said electrode, it is desirable to establish said tube part and the crevice for conductor positioning arranged concentrically in the outside of said end plate section. By preparing this crevice for conductor positioning, a conductor can certainly be concentrically end plate welded [of an electrode] only by inserting the edge of a conductor in said crevice and welding it. For this reason, by closing a conductor concentrically at the edge of a glass tube, an electrode and a glass tube can be arranged concentrically, the homogeneity of the discharge condition in a glass tube and stability can improve, and a lamp life can be raised more.

[0011]

Moreover, since said electrode is formed with the alloy for electrodes concerning above-mentioned this invention (a nickel-W alloy, a nickel-W-Nb alloy, a nickel-W-Ta alloy, or nickel-W-Nb-Ta alloy), it can raise lamp brightness according to an operation of W which could really fabricate by the fabricating-operation nature which was excellent in the electrode alloy, and was excellent in the electron emission characteristic.

[0012]

Moreover, the glass tube with which, as for the fluorescence discharge tube by this invention, the fluorescent screen was formed in the internal surface, and the

gas for discharge was enclosed with the interior, The conductor for feed closed by the both ends of the glass tube in the shape of penetration a glass tube, concentric, and within and without the glass tube, It is arranged inside said glass tube, the electrode for the fluorescence discharge tubes which is the fluorescence discharge tube equipped with the electrode of a couple connected to the edge of said conductor for feed, and is built over above-mentioned this invention as said electrode is used, and joining of said conductor for feed is concentrically carried out to the outside of the end plate section of said electrode. According to this fluorescence discharge tube, it has each effectiveness by the electrode concerning above-mentioned this invention.

[0013]

[Embodiment of the Invention]

the electrode alloy of this invention -- W -- 2.0 - 10mass% -- it contains and consists of a nickel-W alloy which consists of the remainder nickel and an unescapable impurity. this alloy -- the amount of W -- 2.0 - 6.0mass% -- carrying out -- a kind of Nb and Ta, or two sorts -- the total quantity -- 0.5 - 2.0mass% -- it can contain and can consider as a nickel-W-Nb alloy, a nickel-W-Ta alloy, or a nickel-W-Nb-Ta alloy (the nickel-W alloy containing these Nb(s) and Ta may also only be hereafter called nickel-W alloy).

[0014]

The electron emission characteristic of the metallic element which forms an electrode is expressed by the saturation thermionic current (I0) generally searched for by the following formula (formula of Richardson-Dushman), and it excels in the electron emission characteristic, so that I0 is large. If I0 has a work function phi and a fixed absolute temperature T so that clearly from the following formula, the electron emission characteristic will improve, so that the number A of dash men is large. About a work function phi, 4.5eV and W have nickel almost equivalent to 4.6eV, and nickel is [30 and W of the number A of dash men] 70. this -- the electron emission characteristic -- W -- nickel -- a certain thing is understood more than twice. Since the temperature of the back light of the

fluorescence discharge tube, for example, liquid crystal equipment, is regularity (600 degrees C), the amount of electron emission of a nickel-W alloy increases, and its brightness improves, so that the amount of electron emission of the nickel-W alloy in the temperature is higher than nickel and there are many amounts of W. Since too little [at less than 2.0% / the improvement operation in brightness], the amount of W makes the minimum of the amount of W 3.0% preferably 2.0% in this invention.

I0=AT2exp (- phi/kT)

However, T:absolute temperature, phi:work function, k: Boltzmann's constant

[0015]

On the other hand, W reduces the fabricating-operation nature of nickel. If the amount of W exceeds 10% so that clearly from the below-mentioned example, fabricating-operation nature will fall, and it becomes difficult to really fabricate a tubed electrode with impact shaping (closed flange between the colds). For this reason, the upper limit of the amount of W is preferably made into 8% 10%.

[0016]

Nb and Ta are elements which reduce a sputtering yield and have effectiveness in improvement in a lamp life. this invention person only adds these elements slightly into a nickel-W alloy, and did the knowledge of a sputtering yield falling substantially as compared with an addition. At less than 0.5%, since too little [the lowering operation of a sputtering yield], a kind of Nb and Ta or two sorts of total quantities make the minimum of an addition (total quantity) 1.0% preferably 0.5%. On the other hand, if these elements degrade fabricating-operation nature about 2 times as compared with W according to the experiment of an artificer and an addition exceeds 2.0%, when carrying out compound addition of the W, degradation of fabricating-operation nature becomes remarkable. For this reason, the upper limit of an addition (total quantity) is preferably made into 1.5% 2.0%. When adding Nb and Ta, in consideration of degradation of the fabricating-operation nature by these elements, the upper limit of addition of the amount of W is preferably made into 5.0% 6.0%. In addition, the Ta of the reduction

effectiveness of a sputtering yield is larger than Nb so that clearly from the below-mentioned example.

[0017]

Although said electrode alloy contains a high-melting difficulty workability element, after it hot-rolls the casting piece under atmospheric air after casting it under atmospheric air, since it is extremely excellent in a moldability and workability and anneals it under an inert atmosphere like pure nickel if needed, it is easily processible into an about 0.1mm sheet by cold-rolling. And after carrying out finish annealing (softening) if needed, a tubed electrode can be manufactured by carrying out draw forming of said sheet. Moreover, after processing a casting piece into a bar with hot rolling or hot forging, carrying out wire drawing of this, cutting the obtained wire rod to proper die length, obtaining a minor-axis-like raw material (it is called a slag.) and carrying out finish annealing if needed, a tubed electrode can be obtained by carrying out impact shaping of this. When carrying out impact shaping, board thickness of the end plate section of a tubed electrode can be easily thickened as compared with a tubed part, the crevice for conductor positioning can really be easily fabricated in the end plate section further again, and it excels in productivity. in addition, finish annealing -- about 800-950 degrees C -- 3min from -- what is necessary is just to carry out 3hr extent maintenance Although what is necessary is just to perform an annealing ambient atmosphere in a hydrogen gas ambient atmosphere with the nickel-W alloy which does not contain Nb and Ta, when Nb and Ta are included, since it oxidizes and is easy to nitride these elements, it is desirable [elements] to carry out in inert gas ambient atmospheres, such as a vacuum ambient atmosphere or Ar.

[0018]

Next, the fluorescence discharge tube concerning the operation gestalt of this invention and its electrode are explained. Drawing 1 is the important section sectional view of the fluorescence discharge tube concerning an operation gestalt, the fluorescent screen 8 was formed in the internal surface, and this fluorescence discharge tube is equipped with the glass tube 1 with which the gas

for discharge (rare gas and mercury vapour, such as argon gas) was enclosed, and the electrode 2 which constitutes the cold cathode of the couple prepared in the both ends of that glass tube 1.

[0019]

Said electrode 2 is formed in [the tube part 3 from which the end was released, and the end plate section 4 which blockades the end of this tube part 3] one. The crevice 6 for conductor positioning where fitting of the end of said conductor 5 is carried out is formed in said end plate section 4 so that rod-like the conductor 5 and said tube part 3 for feed may be arranged concentrically. Said conductor 5 is closed so that the edge of a glass tube 1 may be penetrated in and abroad, fitting of the edge inside a glass tube 1 is carried out to said crevice 6, and joining is carried out by laser welding, resistance welding, soldering, etc. in the boundary periphery section with the end plate section 4. The lead wire 7 for feed is connected to the other end of said conductor 5 located in the outside of said glass tube 1.

[0020]

While the thickness (thickness [of the part where joining of the conductor 5 is carried out] t) of said end plate section 4 forms said crevice 6, the thick twist of the tube wall of said tube part 3 is also thickly formed so that a conductor 5 can be end plate welded [4] enough. In the small fluorescence discharge tube, the thickness of about 4-10mm and a tube part 3 is formed in about 0.08-0.2mm for the die length of an electrode 2, and the thickness of said end plate section 4 is formed in about 3 to 10 thick times of said tube part 3. In addition, the depth of the crevice 6 in the end plate section 4 is preferably good to make it into twice [more than] tube wall thickness more than the tube wall thickness of a tube part 3, and there should just be thickness of the base of a crevice 6 and a tube part side inner surface more than thick extent of a tube wall.

[0021]

Although said electrode 2 can be formed with pure nickel, it is desirable to form with said nickel-W alloy for electrodes. While having the cold-forming nature of

pure nickel and equivalent extent by using said nickel-W alloy, the brightness of the fluorescence discharge tube can be raised. Furthermore, when Nb and Ta are included, a sputtering yield can be reduced and a lamp life can be raised. This tubed electrode is really fabricated by impact shaping.

[0022]

Although the above-mentioned operation gestalt showed the example in which the crevice 6 for conductor positioning was really fabricated by the end plate section 4, said crevice 6 is not necessarily needed. But since a conductor 5 and the tube part 3 of an electrode 2 are concentrically arranged by forming said crevice 6, by closing said conductor 5 concentrically to a glass tube 1, an electrode 2 and a glass tube 1 can be arranged easily concentrically, ununiformity-ization of a discharge condition can be prevented, and stabilization of discharge and improvement in a lamp life can be aimed at.

[0023]

Although an example is given and this invention is explained more concretely hereafter, this invention is not restrictively interpreted according to this example.

[0024]

[Example]

The nickel-W alloy of the presentation shown in a table 1 was dissolved at 1500 degrees C with the vacuum induction furnace, after carrying out hot forging of the casting piece which cast the molten metal at 1100 degrees C in atmospheric air, it hot-rolled at the rolling initiation temperature of 1100 degrees C, and the hot-rolling plate and the hot-rolling wire rod were obtained. It was annealed in the mixed gas (atmospheric pressure) of nitrogen and hydrogen (it holds 2 hr at 900 degrees C), cold rolling and cold drawing were given, and these hot-rolling material was processed into the sheet metal which is 0.1mm of board thickness, and a wire rod with an outer diameter [phi] of 1.7mm. Workability and a sputtering yield were measured using these samples.

[0025]

Workability was evaluated by the impact shaping trial and the compression test

about the nickel-W alloy which does not contain Nb and Ta. Moreover, the compression test result estimated the impact moldability of the nickel-W alloy containing Nb and Ta.

[0026]

The impact shaping trial cut said wire rod to the slag with a die length of 1.8mm, and was performed by fabricating actually a tubed electrode with bore 1.5mmphi shown in drawing 2 using this after finish annealing (it holds 2 hr at 900 degrees C under a vacuum ambient atmosphere), outer-diameter 1.7mmphi, an overall length [of 5.4mm], and a crevice depth [for conductor positioning] of 0.2mm. Punch of the used die is outer-diameter 1.5mmphi, 150 degrees of point aperture angles, and construction material die steel (SKD11). On the other hand, bores of a die are 1.7mmphi and construction material cemented carbide (D kind No. 6). since it is at the attainment event, and the die was damaged or punch deformed assessment of an impact moldability before the count of shaping reached 1000 shots or, the thing shaping became impossible cannot be fabricated for it -- when (x) and said shots per hour are reached, neither breakage of a die nor deformation of punch arises, but shaping of what was further able to be fabricated is possible -- it considered as (O).

[0027]

The compression test added the load of 1470MPa(s) (150kgf/mm2) to the shaft orientations of said slag, and asked for compressibility (%) by the following type.
Compressibility =(slag die length after application of pressure)/(slag die length before application of pressure) x100

[0028]

Moreover, the sputtering yield was measured by the following points. nickel alloy sheet metal blank test piece (10mmx10mm) was extracted, and mirror polishing of the trial side was carried out. Using ion beam equipment (the product made from Veeco, type:VE-747), said test piece was used as the target, the electrical potential difference (500V) was impressed between the target and the substrate, the trial side was made to carry out an acceleration collision, and sputtering of

the fixed time amount (30min) argon ion (1.3x10-6Torr) was carried out to it. The non-spatter section which masked a part of mirror plane is formed in the trial side, and a level difference is formed in the boundary of the spatter section from which the mirror plane section of a test piece was deleted by sputtering after sputtering, and the masked non-spatter section. This level difference was measured using the contact process relative roughness meter (product [made from Sloan], and type:DEKTAK2A), and it asked for the sputtering yield (%) from the following formula.

Sputtering yield = level difference (A) / spatter time amount (30min) x100

[0029]

The compressibility for which it asked as mentioned above, an impact moldability, and a sputtering yield are collectively shown in a table 1. In addition, for a comparison, the bulk material of pure nickel is prepared and the sputtering yield for which it asked by carrying out sputtering on the same conditions as the above using this is also shown collectively.

[0030]

[A table 1]

試料 No.	組成 mass% W	Nb	Ta	Ni	圧縮率 %	インパクト成形性	スパッタ率 %	備考
1	1.0	—	—	残	50	○	218	比較例
2	2.0	—	—	残	50	○	217	発明例
3	4.0	—	—	残	50	○	196	〃
4	6.0	—	—	残	52	○	210	〃
5	8.0	—	—	残	53	○	208	
6	10.0	—	—	残	55	○	205	〃
7	12.0	—	—	残	57	×	210	比較例
8	5.0	1.0	—	残	54	(○)	185	発明例
9	5.0	—	1.0	残	53	(○)	130	〃
10	4.0	0.7	0.7	残	55	(○)	145	〃
11	—	—	—	100	—	—	214	比較例

[0031]
From a table 1, it is sample No. According to each sample of the nickel-W alloy of 1-8, the amount of W is excellent in the impact moldability to a small tubed electrode at 10.0% or less. A sputtering yield is Nb and Ta although it is pure Nb and equivalent extent Added slight sample No. In 8-10, it turns out that it is falling 10% or more to pure nickel. Moreover, sample No. With the nickel-W alloy containing Nb of 8-10, and Ta, the compressibility is 55% or less, and is sample No. From the relation between the compressibility of 1-7, and an impact moldability, the impact moldability which was excellent also in these samples is expectable.
[0032]
[Effect of the Invention]
The electrode alloy of this invention can raise the brightness of the fluorescence discharge tube as compared with pure nickel, without making nickel contain W

1.0 to 10%, and spoiling the fabricating-operation nature to impact shaping etc. Moreover, when W makes Nb and Ta contain slightly further under 1.0 - 6.0%, it can have the property of said nickel-W alloy, a sputtering yield can be further reduced substantially as compared with an addition, and a lamp life can be improved. Moreover, since the thickness of the end plate section is formed more thickly than the tube wall thickness of a tube part, joining of the conductor for feed can become easy, the electric and thermal junction to an electrode can become certain, and a discharge condition and a heat dissipation condition can be stabilized by the electrode of this invention, and it can prevent lowering of the brightness of the fluorescence discharge tube, and a lamp life, and can raise the manufacture yield of the fluorescence discharge tube.

[Brief Description of the Drawings]

[Drawing 1] It is the important section sectional view of the fluorescence discharge tube equipped with the electrode for the fluorescence discharge tubes concerning the operation gestalt of this invention.

[Drawing 2] It is the sectional view of the electrode for the fluorescence discharge tubes which carried out impact shaping in the example of this invention.

[Drawing 3] It is the important section sectional view of the fluorescence discharge tube equipped with the conventional electrode for the fluorescence discharge tubes.

[Description of Notations]

1 Glass Tube

2 Electrode

3 Tube Part

4 End Plate Section

5 Conductor

6 Crevice for Conductor Positioning

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the important section sectional view of the fluorescence discharge tube equipped with the electrode for the fluorescence discharge tubes concerning the operation gestalt of this invention.

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[Description of Notations]

1 Glass Tube

2 Electrode

3 Tube Part

4 End Plate Section

5 Conductor

6 Crevice for Conductor Positioning

[Translation done.]

* NOTICES *

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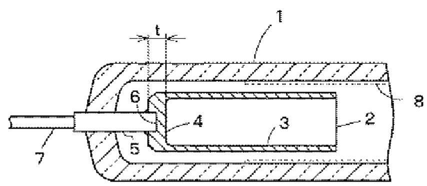
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

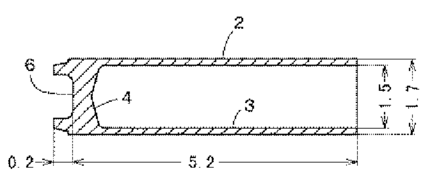
3.In the drawings, any words are not translated.

DRAWINGS

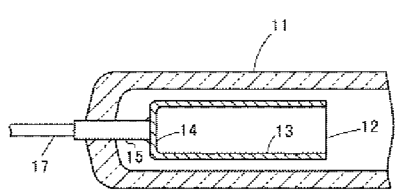
[Drawing 1]



[Drawing 2]



[Drawing 3]



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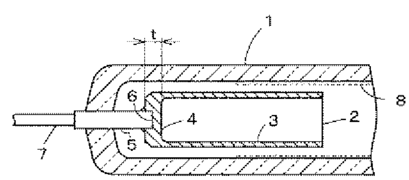
Fターム(参考)　5C015 EE07

(54)【発明の名称】蛍光放電管用電極合金、蛍光放電管用電極およびその電極を備えた蛍光放電管

(57)【要約】
【課題】ランプ輝度が向上し、成形加工性に優れた蛍光放電管用電極合金、蛍光放電管用電極、同電極を備えた蛍光放電管を提供する。
【解決手段】本発明による蛍光放電管用電極合金は、Ｗを２．０～１０ｍａｓｓ％含有し、残部実質的にＮｉからなるＮｉ－Ｗ合金、あるいはＷを２．０～６．０ｍａｓｓ％およびＮｂ、Ｔａのいずれか一種または二種の元素を合計量で０．５～２．０ｍａｓｓ％含有し、残部実質的にＮｉからなるＮｉ－Ｗ－Ｎｂ合金、Ｎｉ－Ｗ－Ｔａ合金あるいはＮｉ－Ｗ－Ｎｂ－Ｔａ合金によって形成される。本発明による蛍光放電管用電極２は、前記電極合金により形成され、一端が解放された管部３と、前記管部３の他端を閉塞する端板部４とを備える。前記端板部４が管部３の管壁厚さよりも厚く形成される。前記端板部４には管部３と同心状に給電用導電体位置決め用凹部６を形成することができる。
【選択図】　図１



【特許請求の範囲】
【請求項1】
Ｗを２．０～１０ｍａｓｓ％含有し、残部実質的にＮｉからなる蛍光放電管用電極合金。
【請求項2】
Ｗを２．０～６．０ｍａｓｓ、ＮｂおよびＴａから選択される１種または２種の元素を合計量で０．５～２．０ｍａｓｓ％含有し、残部実質的にＮｉからなる蛍光放電管用電極合金。
【請求項3】
一端が解放された管部と、前記管部の他端を閉塞する端板部とを備えた蛍光放電管用電極であって、
前記管部と端板部とが請求項１または２に記載した電極合金によって一体的に成形され、前記端板部が管部の管壁厚さよりも厚く形成された蛍光放電管用電極。
【請求項4】
前記端板部は、その外側に前記管部と同心状に配置された導電体位置決め用凹部が設けられた請求項３に記載された蛍光放電管用電極。
【請求項5】
内壁面に蛍光膜が形成され、その内部に放電用ガスが封入されたガラス管と、そのガラス管の両端部にガラス管と同心状かつガラス管の内外に貫通状に封止された給電用導電体と、前記ガラス管の内部に配置され、前記給電用導電体の端部に接続された一対の電極を備えた蛍光放電管であって、
前記電極として請求項３または４に記載された蛍光放電管用電極が用いられ、前記電極の端板部の外側に前記給電用導電体が同心状に溶着された、蛍光放電管。

【発明の詳細な説明】
【０００１】
【発明が属する技術分野】
本発明は、例えば液晶のバックライトとして用いられる蛍光放電管、その電極および電極材に関する。
【０００２】
【従来の技術】
液晶装置にはバックライトとして小形の蛍光放電管が用いられる。かかる蛍光放電管は、図３に示すように、内壁面に蛍光膜（図示省略）が形成され、その内部に放電用ガス（アルゴンガス等の希ガスおよび水銀蒸気）が封入されたガラス管１１と、そのガラス管１１の両端部に設けられた一対の冷陰極を構成する電極１２を備えている。前記電極１２は、一端が解放された筒状の管部１３と、この管部１３の他端を閉塞する端板部１４とによって有底筒状に一体的に形成されている。前記端板部１４には前記ガラス管１１の端部を貫通するように封止された棒状の導電体１５の一端が溶接され、この導電体１５の他端にリード線１７が接続される。
【０００３】
前記電極１２は、従来、純Ｎｉによって形成され、そのサイズは、バックライト等の小形の蛍光放電管用のものでは、例えば内径１．５ｍｍ程度、全長５ｍｍ程度、壁部１３の肉厚０．１ｍｍ程度である。かかる筒状電極は、通常、前記管部の肉厚と同等の厚さを有する純Ｎｉ薄板を深絞り成形することによって一体的に成形される。
【０００４】
蛍光放電管用電極に関する技術として、特開２００２－１１００８５号公報（特許文献１）には、ランプ寿命を向上させるために、電極をスパッタ率の低い、Ｎｂ、Ｔｉ、Ｔａ又はこれらの合金で形成することが記載されている。しかし、これらの高融点酸化性金属は高価である上、プラズマアーク溶解法や粉末冶金法など、通常の溶解・鋳造法とは異なる特殊な方法によってバルク材を製造する必要があり、さらに純Ｎｉに比較して成形加工性が非常に悪く、純Ｎｉのように筒状電極に容易に成形加工することができないという問題がある。

【特許文献１】
特開２０００－３９７３号公報（特許請求の範囲）
【０００５】
【発明が解決しようとする課題】
上記のとおり、蛍光放電管用電極は、主として成形性が良好で、材質的にも安定な純Ｎｉによって形成されていたが、蛍光放電管の小形化に伴って、輝度の向上が求められている。輝度を向上させるには、放電管に封入された放電用ガス（希ガス）の圧力を下げればよいが、点灯の際に電極にイオン等が衝突して電極金属から原子を放出する現象（スパッタリング）が生じ易くなる。この結果、電極金属の原子がガラス管内に封入された水銀と結合し、水銀蒸気を消耗させるので、ランプ寿命が低下するという問題がある。
また、従来の筒状電極は端板部が筒状本体と同等の肉厚しかないため、給電用の導電体を溶接する際の溶接条件が厳しく、溶着不良が生じ易い。このため電極への電気的、熱的接合が不確実となり、放電状態、放熱状態が不安定となり、蛍光放電管の輝度が低下し、またランプ寿命も低下し易くなるという問題がある。
本発明は、かかる問題に鑑みなされたもので、成形加工性に優れ、しかも放電管の輝度を向上させることができる蛍光放電管用電極合金を提供すること、また給電用導電体の溶着不良に起因する輝度の低下、ランプ寿命の低下を防止することができる蛍光放電管用電極を提供すること、さらに上記特徴を備えた蛍光放電管を提供することを目的とする。
【０００６】
【課題を解決するための手段】
本発明による蛍光放電管用電極合金は、Ｗを２．０～１０ｍａｓｓ％含有し、残部実質的にＮｉからなるＮｉ－Ｗ合金、あるいはＷを２．０～６．０ｍａｓｓ％およびＮｂ、Ｔａのいずれか一種または二種の元素を０．５～２．０ｍａｓｓ％含有し、残部実質的にＮｉからなるＮｉ－Ｗ－Ｎｂ合金、Ｎｉ－Ｗ－Ｔａ合金あるいはＮｉ－Ｗ－Ｎｂ－Ｔａ合金によって形成される。
【０００７】
この電極合金によれば、Ｎｉに電子放出特性に優れたＷを適量含むので、純Ｎｉに対して実用上遜色のない成形加工性を確保しつつ、同様の放電条件の下で蛍光放電管の輝度を向上させることができる。また、Ｎｂ、Ｔａの１種または２種を０．５～２．０ｍａｓｓ％と僅かに添加することによって、電極のスパッタ率を低下させることができ、ランプ寿命が向上する。Ｎｂ、Ｔａも成形加工性を劣化させ、その程度はＷより２倍程度大きいので、これらの元素をＷとともに複合添加する場合は、Ｗ量の上限は６．０％にする必要がある。
【０００８】
また、本発明による蛍光放電管用電極は、一端が解放された管部と、前記管部の他端を閉塞する端板部とを備え、前記管部と端板部とが前記電極合金によって一体的に成形され、前記端板部が管部の管壁厚さよりも厚く形成される。
【０００９】
この電極によれば、管部の管壁の厚さが薄い場合であっても、給電用導電体が溶着される端板部の厚さが管部の管壁の厚さよりも厚く形成されるので、前記導電体の端部を端板部に突き合わせ状に溶着する際、溶接出力などの溶着出力の微妙な制御を行うことなく導電体の端部を端板部に容易に溶着することができ、両者の溶着不良を防止することができる。このため、導電体と電極との電気的、熱的接合が確実となり、放電状態、放熱状態が安定し、蛍光放電管の輝度やランプ寿命の低下を防止することができる。また、蛍光放電管の製造歩留まりを向上させることができる。
【００１０】
前記電極において、前記端板部の外側に前記管部と同心状に配置された導電体位置決め用凹部を設けることが好ましい。かかる導電体位置決め用凹部を設けることによって、導電体の端部を前記凹部に差し込んで溶着するだけで、電極の端板部に導電体を同心状に確実に溶着することができる。このため、導電体をガラス管の端部に同心状に封止することに

より、電極とガラス管とが同心状に配置され、ガラス管内における放電状態の均一性、安定性が向上し、ランプ寿命をより向上させることができる。
【００１１】
また、前記電極は上記本発明に係る電極用合金（Ｎｉ－Ｗ合金、Ｎｉ－Ｗ－Ｎｂ合金、Ｎｉ－Ｗ－Ｔａ合金あるいはＮｉ－Ｗ－Ｎｂ－Ｔａ合金）で形成されるので、その電極合金の優れた成形加工性によって一体成形することができ、また電子放出特性の優れたWの作用によりランプ輝度を向上させることができる。
【００１２】
また、本発明による蛍光放電管は、内壁面に蛍光膜が形成され、その内部に放電用ガスが封入されたガラス管と、そのガラス管の両端部にガラス管と同心状かつガラス管の内外に貫通状に封止された給電用導電体と、前記ガラス管の内部に配置され、前記給電用導電体の端部に接続された一対の電極を備えた蛍光放電管であって、前記電極として上記本発明にかかる蛍光放電管用電極が用いられ、前記電極の端板部の外側に前記給電用導電体が同心状に溶着されたものである。この蛍光放電管によれば、上記本発明にかかる電極による各効果を備える。
【００１３】
【発明の実施の形態】
本発明の電極合金は、Wを２．０～１０ｍａｓｓ％含有し、残部Ｎｉおよび不可避的不純物からなるＮｉ－W合金からなるものである。この合金には、W量を２．０～６．０ｍａｓｓ％とし、Ｎｂ、Ｔａの一種あるいは二種を合計量で０．５～２．０mass％含有することができ、Ｎｉ－Ｗ－Ｎｂ合金、Ｎｉ－Ｗ－Ｔａ合金あるいはＮｉ－Ｗ－Ｎｂ－Ｔａ合金（以下、これらのNb、Ｔａを含むＮｉ－W合金も単にＮｉ－W合金という場合がある。）とすることができる。
【００１４】
電極を形成する金属元素の電子放出特性は、一般的に下記式（Ｒｉｃｈａｒｄｓｏｎ－Ｄｕｓｈｍａｎの式）で求められる飽和熱電子電流（I_0）によって表され、I_0が大きいほど電子放出特性に優れる。下記式から明らかなように、I_0は仕事関数φ、絶対温度Ｔが一定であれば、ダッシュマン定数Ａが大きいほど電子放出特性は向上する。仕事関数φについてはＮｉが４．５ｅＶ、Wが４．６ｅＶとほぼ同等であり、ダッシュマン定数ＡはＮｉが３０、Wが７０である。これより、電子放出特性はWがＮｉの２倍以上あることがわかる。蛍光放電管、例えば液晶装置のバックライトの温度は一定（６００℃）であるので、その温度におけるＮｉ－W合金の電子放出量はＮｉより高く、W量が多いほどＮｉ－W合金の電子放出量は増大し、輝度が向上する。W量が２．０％未満では輝度向上作用が過少であるので、本発明ではW量の下限を２．０％、好ましくは３．０％とする。
$I_0 = AT2\exp(-\phi/kT)$
但し、Ｔ：絶対温度、φ：仕事関数、ｋ：ボルツマン定数
【００１５】
一方、WはＮｉの成形加工性を低下させる。後述の実施例から明らかなように、W量が１０％を超えると成形加工性が低下し、インパクト成形（冷間閉塞鍛造）によって筒状電極を一体成形することが困難になる。このため、W量の上限を１０％、好ましくは8％とする。
【００１６】
Ｎｂ、Ｔａはスパッタ率を低下させ、ランプ寿命の向上に効果がある元素である。本発明者は、これらの元素をＮｉ－W合金に僅かに添加するだけで、添加量に比してスパッタ率が大幅に低下することを知見した。Ｎｂ、Ｔａの一種または二種の合計量が０．５％未満では、スパッタ率の低下作用が過少であるので、添加量（合計量）の下限を０．５％、好ましくは１．０％とする。一方、発明者の実験によると、これらの元素はWに比して２倍程度成形加工性を劣化させ、添加量が２．０％を超えると、Wを複合添加する場合、成形加工性の劣化が著しくなる。このため、添加量（合計量）の上限を２．０％、好ましくは１．５％とする。Ｎｂ、Ｔａを添加する場合、これらの元素による成形加工性の劣化を考

慮して、Ｗ量の添加の上限を６．０％、好ましくは５．０％とする。なお、後述の実施例から明らかなように、Ｔａの方がＮｂよりもスパッタ率の低減効果は大きい。

【００１７】

前記電極合金は、高融点の難加工性元素を含むものの、純Ｎｉと同様、成形性、加工性に極めて優れるので、大気下で鋳造した後、その鋳造片を大気下で熱間圧延し、必要に応じて不活性雰囲気下で焼鈍した後、冷間圧延することにより０．１ｍｍ程度のシートに容易に加工することができる。そして、必要に応じて仕上焼鈍（軟化焼鈍）した後、前記シートを絞り成形することによって、筒状電極を製造することができる。また、鋳造片を熱間圧延や熱間鍛造によって棒材に加工し、これを伸線し、得られた線材を適宜の長さに切断して短軸状素材（スラグという。）を得て、必要に応じて仕上焼鈍した後、これをインパクト成形することによって筒状電極を得ることができる。インパクト成形する場合、筒状電極の端板部の板厚を筒状部に比して容易に厚くすることができ、さらにまた端板部に導電体位置決め用の凹部を容易に一体成形することができ、生産性に優れる。なお、仕上焼鈍は、８００～９５０℃程度で３ｍｉｎ　から３ｈｒ程度保持すればよい。焼鈍雰囲気は、Ｎｂ、Ｔａを含まないＮｉ－Ｗ合金では水素ガス雰囲気中で行えばよいが、Ｎｂ、Ｔａを含む場合は、これらの元素は酸化および窒化し易いので、真空雰囲気あるいはＡｒ等の不活性ガス雰囲気中で行うことが好ましい。

【００１８】

次に、本発明の実施形態にかかる蛍光放電管およびその電極について説明する。図１は、実施形態にかかる蛍光放電管の要部断面図であり、この蛍光放電管は、内壁面に蛍光膜８が形成され、放電用ガス（アルゴンガス等の希ガスおよび水銀蒸気）が封入されたガラス管１と、そのガラス管１の両端部に設けられた一対の冷陰極を構成する電極２を備えている。

【００１９】

前記電極２は、一端が解放された管部３と、この管部３の一端を閉塞する端板部４とが一体的に形成されている。前記端板部４には、給電用の棒状の導電体５と前記管部３とが同心状に配列されるように、前記導電体５の一端が嵌合される導電体位置決め用凹部６が形成されている。前記導電体５は、ガラス管１の端部を内外に貫通するように封止され、ガラス管１の内側の端部が前記凹部６に嵌合され、端板部４との境界外周部においてレーザ溶接、抵抗溶接、ろう付けなどによって溶着されている。前記ガラス管１の外側に位置する、前記導電体５の他端には給電用のリード線７が接続される。

【００２０】

前記端板部４の厚さ（導電体５が溶着される部位の厚さｔ）は、前記凹部６を形成するとともに導電体５を端板部４に十分溶着することができるように、前記管部３の管壁の肉厚よりも厚く形成されている。小形の蛍光放電管では、電極２の長さは４～１０ｍｍ程度、管部３の肉厚は０．０８～０．２ｍｍ程度に形成され、前記端板部４の厚さは前記管部３の肉厚の３～１０倍程度に形成される。なお、端板部４における凹部６の深さは管部３の管壁厚さ以上、好ましくは管壁厚さの２倍以上とするのがよく、また凹部６の底面と管部側内面との肉厚は管壁の肉厚程度以上あればよい。

【００２１】

前記電極２は、純Ｎｉで形成することができるが、前記電極用Ｎｉ－Ｗ合金で形成することが好ましい。前記Ｎｉ－Ｗ合金を用いることにより、純Ｎｉと同等程度の冷間成形性を有するとともに、蛍光放電管の輝度を向上させることができる。さらに、Ｎｂ、Ｔａを含む場合は、スパッタ率を低減することができ、ランプ寿命を向上させることができる。この筒状電極は、インパクト成形によって一体成形される。

【００２２】

上記実施形態では、導電体位置決め用凹部６が端板部４に一体成形された例を示したが、前記凹部６は必ずしも必要としない。もっとも、前記凹部６を形成することによって、導電体５と電極２の管部３とが同心状に配置されるので、前記導電体５をガラス管１に同心状に封止することによって、電極２とガラス管１とを同心状に容易に配置することができ

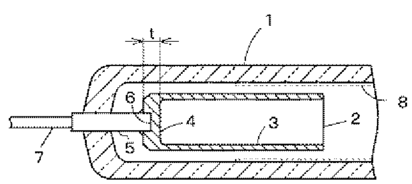
、放電状態の不均一化を防止することができ、放電の安定化、ランプ寿命の向上を図ることができる。
【００２３】
以下、実施例を挙げて本発明をより具体的に説明するが、本発明はかかる実施例によって限定的に解釈されるものではない。
【００２４】
【実施例】
表１に示す組成のＮｉ－Ｗ合金を真空誘導炉にて１５００℃にて溶解し、その溶湯を鋳造した鋳造片を大気中で１１００℃で熱間鍛造した後、圧延開始温度１１００℃で熱間圧延を行い、熱延板および熱延線材を得た。これらの熱延材は窒素および水素の混合ガス（大気圧）中で焼鈍（９００℃で２ｈｒ保持）され、冷間圧延および冷間伸線が施され、板厚０．１ｍｍの薄板、外径１．７ｍｍφの線材に加工された。これらの試料を用いて加工性およびスパッタ率が測定された。
【００２５】
加工性は、Ｎｂ、Ｔａを含まないＮｉ－Ｗ合金についてはインパクト成形試験および圧縮試験によって評価した。また、Ｎｂ、Ｔａを含むＮｉ－Ｗ合金のインパクト成形性については圧縮試験結果によって評価した。
【００２６】
インパクト成形試験は、前記線材を１．８ｍｍの長さのスラグに切断し、仕上焼鈍（真空雰囲気下、９００℃で２ｈｒ保持）後、これを用いて図２に示す、内径１．５ｍｍφ、外径１．７ｍｍφ、全長５．４ｍｍ、導電体位置決め用凹部深さ０．２ｍｍの筒状電極を実際に成形することによって行われた。用いた成形型のパンチは、外径１．５ｍｍφ、先端部開き角１５０°、材質ダイス鋼（ＳＫＤ１１）である。一方、ダイは、内径は１．７ｍｍφ、材質超硬合金（Ｄ種６号）である。インパクト成形性の評価は、成形回数が１０００ショットに到達する前あるいは到達時点でダイが破損し、あるいはパンチが変形したため、成形が出来なくなったものを成形不可（×）、前記ショット数に到達した時点でダイの破損やパンチの変形が生じず、さらに成形可能であったものを成形可能（○）とした。
【００２７】
圧縮試験は、前記スラグの軸方向に１４７０ＭＰａ（１５０ｋｇｆ／mm^2）の荷重を付加し、下記式により圧縮率（％）を求めた。
圧縮率＝（加圧後のスラグ長さ）／（加圧前のスラグ長さ）×１００
【００２８】
また、スパッタ率は以下の要領により測定された。Ｎｉ合金薄板から試験片（１０ｍｍ×１０ｍｍ）を採取し、試験面を鏡面研磨した。イオンビーム装置（Ｖｅｅｃｏ社製、型式：ＶＥ－７４７）を用いて、前記試験片をターゲットとし、ターゲットと基板との間に電圧（５００Ｖ）を印加し、一定時間（３０ｍｉｎ　）アルゴンイオン（1.3×10^{-6} Ｔｏｒｒ）を試験面に加速衝突させ、スパッタリングした。試験面には鏡面の一部をマスキングした非スパッタ部が形成されており、スパッタリング後には、スパッタリングによって試験片の鏡面部が削られたスパッタ部とマスキングされた非スパッタ部との境界に段差が形成される。この段差を接触式粗度計（Ｓｌｏａｎ社製、型式：ＤＥＫＴＡＫ２Ａ）を用いて測定し、下記式からスパッタ率（％）を求めた。
スパッタ率＝段差（Å）／スパッタ時間（３０ｍｉｎ　）×１００
【００２９】
以上のようにして求めた圧縮率、インパクト成形性、スパッタ率を表１に併せて示す。なお、比較のため、純Ｎｉのバルク材を準備し、これを用いて上記と同様の条件でスパッタリングすることによって求めたスパッタ率も併せて示す。
【００３０】
【表１】

試料No.	組成 mass%				圧縮率 %	インパクト成形性	スパッタ率 %	備考
	W	Nb	Ta	Ni				
1	1.0	－	－	残	50	○	218	比較例
2	2.0	－	－	残	50	○	217	発明例
3	4.0	－	－	残	50	○	196	〃
4	6.0	－	－	残	52	○	210	〃
5	8.0	－	－	残	53	○	208	
6	10.0	－	－	残	55	○	205	〃
7	12.0	－	－	残	57	×	210	比較例
8	5.0	1.0	－	残	54	(○)	185	発明例
9	5.0	－	1.0	残	53	(○)	130	〃
10	4.0	0.7	0.7	残	55	(○)	145	〃
11	－	－	－	100	－	－	214	比較例

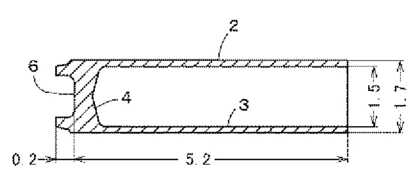
【００３１】
表１より、試料Ｎｏ．　１～８のＮｉ－Ｗ合金の各試料によると、Ｗ量が１０．０％以下では、小形筒状電極に対するインパクト成形性に優れる。スパッタ率は純Ｎｂと同等程度であるが、Ｎｂ、Ｔａを僅かな添加した試料Ｎｏ．　８～１０では、純Ｎｉに対して１０％以上低下していることが分かる。また、試料Ｎｏ．　８～１０のＮｂ、Ｔａを含むＮｉ－Ｗ合金では、その圧縮率は５５％以下であり、試料Ｎｏ．　１～７の圧縮率とインパクト成形性との関係から、これらの試料においても優れたインパクト成形性を期待することができる。
【００３２】
【発明の効果】
本発明の電極合金は、ＮｉにＷを１．０～１０％含有させたものであり、インパクト成形等に対する成形加工性を損なうことなく、純Ｎｉに比して蛍光放電管の輝度を向上させることができる。また、Ｗが１．０～６．０％の下でさらにＮｂ、Ｔａを僅かに含有させることにより、前記Ｎｉ－Ｗ合金の特性を備え、さらにスパッタ率を添加量に比して大幅に低下させることができ、ランプ寿命を改善することができる。また、本発明の電極は、端板部の厚さが管部の管壁厚さより厚く形成されているので、給電用導電体の溶着が容易になり、電極への電気的、熱的接合が確実となり、放電状態、放熱状態が安定し、蛍光放電管の輝度、ランプ寿命の低下を防止することができ、また蛍光放電管の製造歩留まりを向上させることができる。
【図面の簡単な説明】
【図１】本発明の実施形態にかかる蛍光放電管用電極を備えた蛍光放電管の要部断面図である。
【図２】本発明の実施例においてインパクト成形した蛍光放電管用電極の断面図である。
【図３】従来の蛍光放電管用電極を備えた蛍光放電管の要部断面図である。
【符号の説明】
１　ガラス管
２　電極
３　管部
４　端板部
５　導電体

6　導電体位置決め用凹部

【図1】



【図2】



【図3】